



Improving Products of Vegetable Types in Dryland on Potatoes Compost Waste Basis and Cattle Rumen



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Abstract

The research has been conducted to determine the effect of potato waste compost + cattle rumen to increase soil fertility and the product of several vegetable kinds. The research location was in Desa Candikuning, Bedugul, Bali with altitude was 1,247 m above the sea level. The climate types including B₃ with 7-8 months on wet and 4 -5 months on dry. The research was conducted from May to October 2014 using a Randomized Block Design of nested pattern factorial. The treatment was attempted was potato waste compost + cattle rumen towards several kinds of vegetables, each treatment was replicated three times. The research results of nutrient consist of potato waste compost + cattle rumen showed C-organic was 6.940% N-Total, 0.310% P-provided, 23.69 ppm and 0.340% K-Total. The application of potato waste compost + cattle rumen increased a soil of C-organic from 1.840% to be 3.75%, N-Total of soil increased from 0.159 to be 0.260%, P-Provided of increasing soil from 437.180 ppm to be 2900 ppm and K-Total of increasing soil from 0.04% to be 0.08%. The treatment of potato waste compost + cattle rumen showed the significantly increasing for five kinds of vegetables were attempted. Four vegetable types crops were attempted, namely lettuce, green vegetables, phak choy, and spinach unplug showed a variety of improvement, it was a very real and not real. However, on Kaylan, potato waste composting + cattle rumen was no significant effect.

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1. Introduction

On the one hand, the potatoes products are average in the Desa Candikuning (Candikuning Village) is 20 t ha^{-1} with a waste potential $\pm 3.0 \text{ t ha}^{-1}$, based on the area of the potato crop is 62 ha, the waste potential $\pm 186 \text{ t}$ (Anon, 2012). The waste potato consist of a lot of nutrients, due to the potatoes including crops were very greedy to absorb nutrients during the growth process. According to Sutanto (2006), the former land planted potatoes lose their nutrients N, P, and K in the amount 4-10 times more than the former land that has been planted broccoli.

On the other hand, it is provided with a lot of waste from slaughter cattle rumen (Abattoirs) that can be used to nutritional potato harvest waste decomposition in the composting process. The nutritional consist of waste punch includes 8.86% protein, 2.60% fat, crude fiber 28.78%, phosphorus 0.55%, ash 18.54% and 10.92% water (Widodo, 2002). If the two organic materials are returned to the soil are expected to improve the physical, chemical, and biological soil and increase crop productivity. The mechanical repayment is conducted by composting. According to Foth (1994); Blair *et al.*, (1995); Tan (2005), an organic substance is able to influence the physical, chemical, and biological soil. The organic soil material consist of 3-5% of the soil weight in the *topsoil* mineral soils represent (Buckman & Brady, 1982). Therefore, it has developed a model of organic matter management technology in the form of compost at the local specific in Desa Candikuning.

The result studies regarding compost treatment included: vegetable waste compost + tofu + baker + EM4 showed the highest parameters on plant height, number, diameter, and bulb weight of onion crop (Ismandri *et al.*, 2007). Abdurohim (2008), research results show the compost provides increased levels of potassium in the soil was higher than that Potassium supplied NPK fertilizer, however, phosphorus levels did not show significant differences with NPK.

In term of this led growth of causing plants (*Brassica oleracea*) are significantly different. The compost and EM at increasing N, P and K is compared to compost without EM, although Fe in compost with EM is much higher than the compost without EM, for Zn and Cu, there was no significant difference (Jusoh *et al.*, 2013). The utilization of other organic material indicates that the use of livestock manure is able to increase the availability of C-organic soil and soil quality (Sang *et al.*, 2014; Linlin *et al.*, 2014; Lene *et al.*, 2006). Furthermore, the changes in soil agricultural to industrial or urbanization causes changes in C-organic soil (Lefeng *et al.*, 2013).

2. Materials and Methods

The study was conducted from May to October in 2014 at Desa Candikuning Bedugul, Tabanan, Bali over altitude was 1,247 m above the sea level. The climate types including B₃ for 7-8 months on wet and 4 -5 months on dry (Oldeman *et al.*, 1980 in Daryono, 2002). The research implementation:

1. Composting Process of Potatoes Waste

The potatoes waste is chopped of small and length is $\pm 10 \text{ cm}$. Subsequently, it is incorporated into the pits with depth is 1 m, width is 1.5 m and a length is 1.5 m. For each thickness is 15 cm sprinkled soil about 5 cm and 1 kg of cattle rumen. It should not be used more than one week from the harvest time. During the composting process, it is performed reversal takes place 6 times, which is currently 7, 15, 30, 45, 60 and 75 days. The compost is categorized after 90 days old and ready to be applied to the experimental plot. The compost produced is analyzed in Soil Laboratory to determine the consistency of their element.

2. Preparation of Experimental Plots

The soil wherein the experiments are processed and made experimental plots, per plot size is $200 \text{ cm} \times 200 \text{ cm}$ as many as 30 pieces, then coded randomized treatment. Further, an experimental plot is treated according to the level some vegetables types (S) and potato waste compost + cattle rumen (L). The dose is given on composting treatment plot is 10 t ha^{-1} or 4 kg per plot for dry wind. Before treating carried out, then the soil is analyzed in the Soil Laboratory.

3. Treatment and Experiments Design

Nested Experiment is applied in the present study with Randomized Block Design is repeated 3 times. The treatment consists of two factors, i.e. some vegetables types (S) and the potato harvest waste compost + cattle rumen (L).

4. Planting of Vegetable Plants Treatment

The planting follows the farmer's cultivation technical habits unlike plant spacing, nursery, weeding, watering, pest and disease control. The use of inorganic fertilizers e.g. Urea, KCl and TSP were not performed.

5. Observation Parameter

The parameters are measured in the harvest. The harvest for each vegetable crops varies according to the crop harvest old. It is measured the result of some vegetable type of plants from samples plant (20% of the number of plants per plot) is taken randomly, included: Total weight of fresh plant⁻¹ (g); Total fresh plant weight ha⁻¹ (t); fresh weight economical plant⁻¹ (g); plants economical fresh weight ha⁻¹ (t); fresh weight of non-economical plant⁻¹ (g) and fresh weight non-economical ha⁻¹ (t).

6. Data Analysis

Data is analyzed by ANOVA on the nested experiment with Randomized Block Design then using Least Significant Difference level is 5% (Steel & Torrie 1991; Gasperz, 1991).

3. Results and Discussions

The results of chemical analysis of compost and soil

Table 1
Chemical Analysis Results

Analysis Type	Potato Waste Compost + Cattle Rumen		Soil Before		Soil after 2 weeks initiated application potato waste compost + cattle rumen	
	Value	Remarks	Value	Remarks	Value	Remarks
pH :						
H ₂ O	6,750	N	6,260	AA	5,59	AA
C-Organic (%)	6,940	ST	1,840	R	3,75	T
N-Total (%)	0,310	S	0,159	R	0,260	S
P-Provide (ppm)	23,69	S	437,18	ST	290,00*	ST
K-Total (%)	0,340	S	0,040	SR	0,08	SR

Source: Lab. Soil Science, Faculty of Agriculture, University of Udayana, Bali, Indonesia and Lab. Soil Department, Faculty of Agriculture, the University of Gadjah Mada in Yogyakarta, Indonesia.

Description: * P Total (ppm), AA = Medium Acid, T = High, ST = Very High,
R = Low, SR = Very Low, N = Neutral, S = Medium

The nutrient of potato waste compost + cattle rumen produces the highest C-organic i.e. 6.940%, whereas, the content of N-total, P provided and K Total each medium (Table 1). The compost application effect of potato waste + cattle rumen after 2 weeks increases: C-organic than 1.840% (low), to be 3.75% (high), N-total of 0.159 (low) to be 0,260% (medium), P-provided is increased from 437.180 ppm (very high) into P-Total 0.29%, equivalent to 2900 ppm (very high), K-Total of soil 0.04% to be 0.08% (Table 1), although still in a very low strata.

3.1 The observation results in the composting effect to increasing for some vegetable types

The treatment of potato waste compost + cattle rumen give varieties effect to four types of vegetables is attempted. They are Lettuce, Green vegetables, Phak Choy and Spinach Unplug shows the real effect, very real and not real. However, in Kaylan, potato waste composting + cattle rumen no significant effect (Table 2).

Table 2

The significance of the potato waste compost effect + cattle rumen in some vegetables (L on S) towards the parameters observed

No	Parameter	L on S				
		S ₁	S ₂	S ₃	S ₄	S ₅
1.	The total fresh weight of plant ⁻¹ (g)	*	**	**	**	ns
2.	The total plant fresh weight ha ⁻¹ (t)	**	**	**	**	ns
3.	Fresh Weight economical plant ⁻¹ (g)	**	**	**	*	ns
4.	Fresh weight economical plant ha ⁻¹ (t)	**	**	**	**	ns
5.	Weight of fresh non economical plant ⁻¹ (g)	ns	*	*	ns	ns
6.	The non-economical fresh weight ha ⁻¹ (t)	ns	ns	**	ns	ns

Description: S₁ = Lettuce; S₂ = Green vegetables; S₃ = Phakcoy; S₄ = Spinach Pull;

S₅ = Kaylan; ns = No real effect; * = Real effect;

** = Highly significant effect

3.2 Total fresh weight of plant⁻¹ and ha⁻¹

In the lettuce plants, potato waste composting + cattle rumen increase the fresh weight of the total plant⁻¹ and ha⁻¹ with a real respectively 29.71% (204.13 g) and 50.86% (47.49 t) compared with no provision of potato waste compost + cattle rumen i.e. respectively by 157.37 and 31.48 g t (Table 3, Figure 1).

Upon green vegetable plants, composting waste potatoes + cattle rumen increase the fresh weight of the total plant⁻¹ and ha⁻¹ with a real respectively 174.06% (247.20 g) and 173.93% (61.77 t) is compared with no provision of potato waste compost + cattle rumen i.e. respectively 90.20 and 22.55 g t (Table 3, Figure 1).

For phak choy plants, composting waste potatoes + cattle rumen increase the fresh weight of the total plant⁻¹ and ha⁻¹ with a real respectively 196.97% (158.88 g) and 196.93% (70.61 t) compared with no provision of potato waste compost + cattle rumen i.e. respectively 53.50 and 23.78 g t (Table 3, Figure 1).

In the spinach pull plants, composting waste potatoes + cattle rumen increase the fresh weight of the total plant⁻¹ and ha⁻¹ with a real respectively 133.17% (93.57 g) and 133.11% (31.19 t) compared with no provision of potato waste compost + cattle rumen i.e. respectively 40.13 and 13.38 g t (Table 3, Figure 1).

At the kaylan plants, composting waste potatoes + cattle rumen does not increase the total fresh weight of plant⁻¹ and ha⁻¹. However, the provision of potato waste compost + cattle rumen still leaves tendency the fresh weight and total plant⁻¹ ha⁻¹ higher than the administration without giving potato waste compost + cattle rumen (Table 3, Figure 1).

Table 3

An average of total fresh weight plant⁻¹ and ha⁻¹ due to the potato waste compost effect + cattle rumen of some vegetables (L on S)

Treatment	The total fresh weight of plant ⁻¹ (g)	The total plant fresh weight ha ⁻¹ (t)	Fresh Weight economical plant ⁻¹ (g)	Fresh weight economical plant ha ⁻¹ (t)	Weight of fresh non-economical plant ⁻¹ (g)	The non-economical fresh weight ha ⁻¹ (t)
L on S ₁ :						
- (L ₀)	157,37 b	31,48 b	156,67 b	31,33 b	0,70 a	0,14 a
- (L ₁)	204,13 a	47,49 a	236,67 a	47,33 a	0,80 a	0,16 a
BNT 5%	15,71	5,17	19,53	5,16	ns	ns
L on S ₂ :						
- (L ₀)	90,20 b	22,55 b	90,00 b	22,50 b	0,20 b	0,05 a
- (L ₁)	247,20 a	61,77 a	246,67 a	61,67 a	0,53 a	0,10 a
BNT 5%	15,71	5,17	19,53	5,16	0,15	ns
L on S ₃ :						
- (L ₀)	53,50 b	23,78 b	53,33 b	23,70 b	0,17 b	0,07 b

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- (L ₁)	158,88 a	70,61 a	158,33 a	70,37 a	0,55 a	0,24 a
BNT 5%	15,71	5,17	19,53	5,16	0,15	0,04
L on S ₄ :						
- (L ₀)	40,13 b	13,38 b	40,00 b	13,33 b	0,17 a	0,04 a
- (L ₁)	93,57 a	31,19 a	93,33 a	31,11 a	0,20 a	0,08 a
BNT 5%	15,71	5,17	19,53	5,16	ns	ns
L on S ₅ :						
- (L ₀)	85,77 a	21,45 a	85,00 a	21,25 a	0,77 a	0,20 a
- (L ₁)	114,29 a	28,57 a	113,33 a	28,33 a	0,96 a	0,24 a
BNT 5%	ns	ns	ns	ns	ns	ns

Description: L₀ = without using of potato waste compost + cattle rumen; L₁ = using the potato waste compost + cattle rumen.

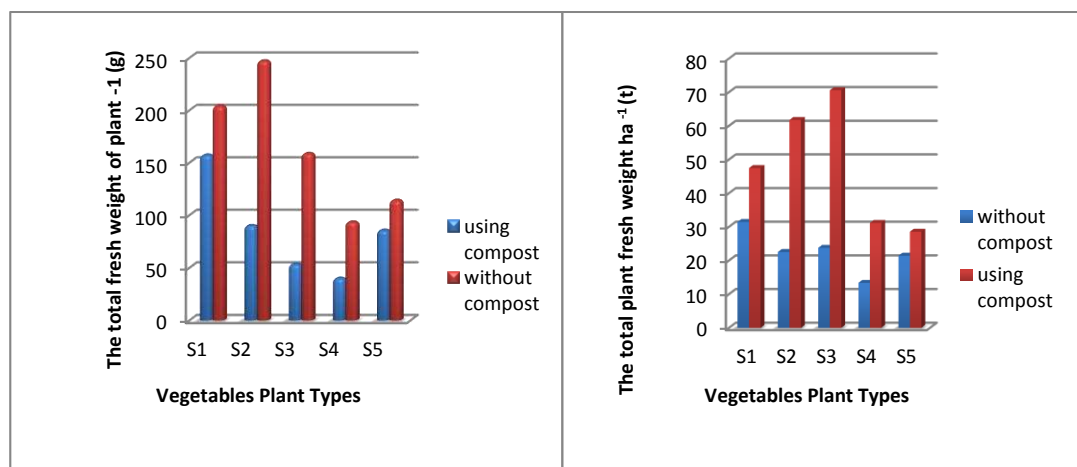


Figure 1. Histogram of the fresh weight total plant-1 and ha-1 due to the provision of potato waste compost + cattle rumen in some vegetable type

3.3 Economic fresh weight of plant⁻¹ and ha⁻¹

In the lettuce plants, potato waste composting + cattle rumen increases the weight of fresh economic plant⁻¹ and ha⁻¹ with a real respectively 51.06% (236.67 g) and 51.07% (47.33 t) compared with no provision of potato waste compost + cattle rumen i.e. respectively 156.67 and 31.33 g t (Table 3, Figure 2).

In the green vegetable plants, composting waste potatoes + cattle rumen increases the weight of fresh economic plant⁻¹ and ha⁻¹ with a real respectively 174.08% (246.67 g) and 174.09% (61.67 t) compared with no provision of potato waste compost + cattle rumen i.e. respectively 90.00 and 22.50 g t (Table 3, Figure 2).

In the phak choy plants, composting waste potatoes + cattle rumen increases the weight of fresh economic plant⁻¹ and ha⁻¹ with a real respectively 196.89% (158.33 g) and 196.92% (70.37 t) compared with no provision of potato waste compost + cattle rumen i.e. respectively 53.33 and 23.70 g t (Table 3, Figure 2).

In spinach pull plants, composting waste potatoes + cattle rumen increases the weight of fresh economic plant⁻¹ and ha⁻¹ with a real respectively 133.33% (93.33 g) and 133.38% (31.11 t) compared with no provision of potato waste compost + cattle rumen i.e. respectively 40.00 and 13.33 g t (Table 3, Figure 2).

In the kaylan plants, composting waste potatoes + cattle rumen does not able to improve the fresh weight economic plant-1 and ha-1. However, the provision of potato waste compost + cattle rumen still provide economic tendency fresh weight plant-1 and ha-1 is higher than the provision of treatment without waste composting potato + cattle rumen (Table 3, Figure 2).

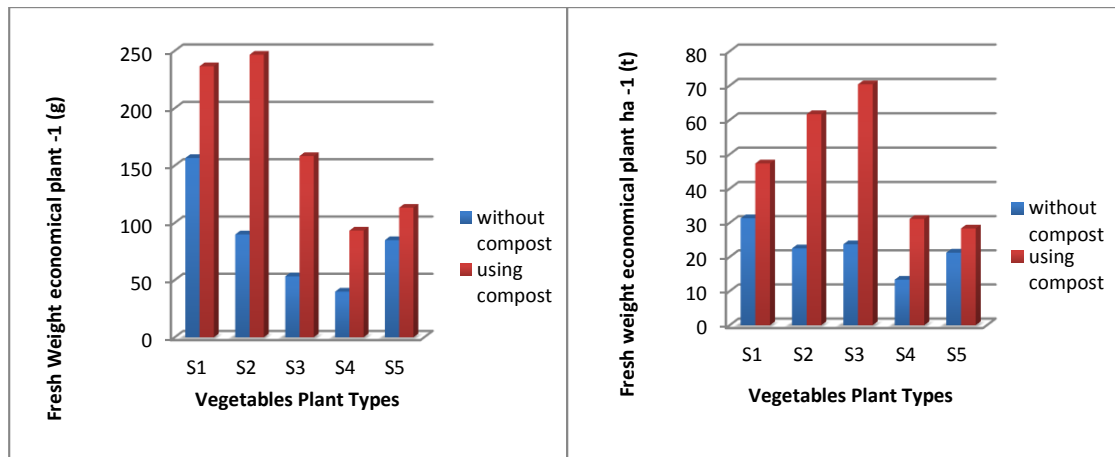


Figure 2. Histogram of an economic fresh weight plant $^{-1}$ and ha $^{-1}$ due to the provision of potato waste compost + cattle rumen in vegetable types

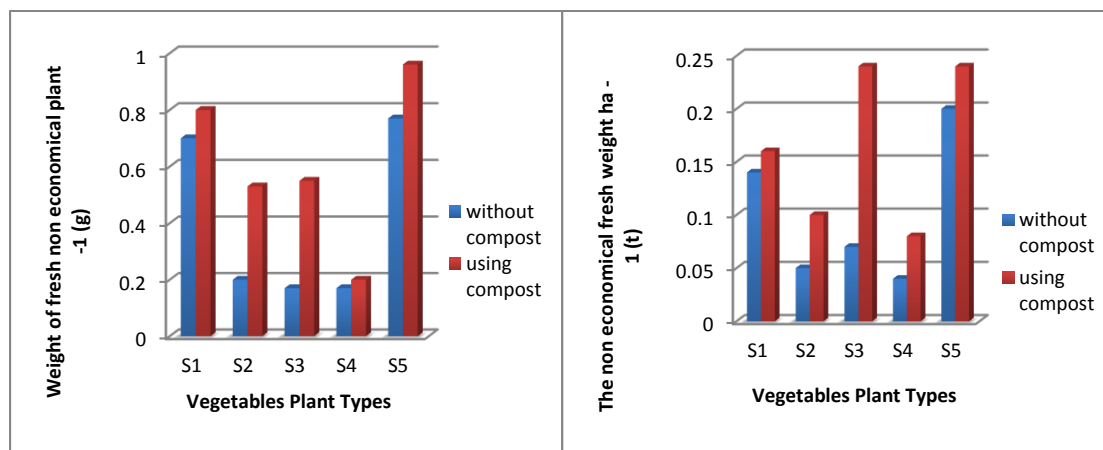


Figure 3. Histogram of non-economic fresh weight plant $^{-1}$ and ha $^{-1}$ due to provisioning the potato waste compost + cattle rumen for some vegetable types

3.4 Discussion

The high nutrient consist of compost (Table 1) is caused at during the composting process occurs mineralization of nutrients, therefore, the nutrient becomes detached and provided. The potato waste compost + cattle rumen contents have decomposed process of decay which is enough for 3 months. This is due to the nutrients consist of cattle rumen useful as an energy source for a variety of microorganisms to increase the population and waste decomposition activity the potato harvest, thus unlike to accelerate the composting process. The organic material is an energy source for microorganisms, the higher nutrient consists of organic matter and high population increasingly active microorganisms (Zhen Zhen *et al.*, 2014).

At improving the soil fertility by composting (Table 1) led to increasing the vegetable products planted. The treatment of potato waste compost + cattle rumen has a varied effect on the five vegetables types are attempted. The four vegetable plant types are attempted, namely lettuce, green vegetables, phak choy, and spinach unplug show the influence of the real and unreal. However, in kaylan, the potato waste composting does not provide any real effect (Table 2). These varied influences caused by genotype factors of vegetable species tested, which are five types of

vegetables genotyping attempted have compliance by environmental conditions (soil and climate) are different each other.

4. Conclusion

Based on the research results and discussion, it can be concluded as follows:

- a) The potato waste compost + cattle rumen consist of C-organic (6.940%), N-Total (0.31%), P-provided (23.69 ppm) and K-Total (0.34%).
- b) An application of potato waste compost + cattle rumen after 2 weeks increase the soil of C-organic from 1.840% to 3.75%, N- soil total from 0.159% to 0.260%, P- soil total from 437.180 ppm to 2900 ppm and K-soil total is 0.04% to 0.08%.
- c) Treatment of potato waste compost + cattle rumen contents varied to give effect to five kinds of vegetables is attempted. Four types of vegetable crops are attempted, namely Lettuce, Green vegetables, Phak Choy, and Spinach Unplug shows the real effect, is a very real and not real. However, on Kaylan, potato waste composting + cattle rumen no significant effect.

Suggestions

Based on the conclusion, it can be concluded as follows:

- a) In order to improve the product of some vegetable types in the research location, or other areas that have a similar environmental, then is recommended use of potato waste compost + cattle rumen in accordance with the dose of 10 t ha⁻¹.
- b) Need to do further research to find out how much residue left by potato waste compost + cattle rumen contents in the first planting to the next crop product, so the products can be compared. Furthermore, the results of the first and second crop can be used as a basis for a recommendation to the farmers.

Conflict of interest statement and funding sources

The author(s) declared that (s)he/they have no competing interest. The study was financed by the authors.

Statement of authorship

The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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Biography of Authors

	<p>The author is I Nengah Karnata the fifth child of six siblings. His parents were deceased, I Wayan Regeg and Ni Made Srinasih. The author was born in a pit of dormitory Badung Resort Police on September 11, 1966. In the Birth Certificate and Certificate written birthplace: Pekambingan, Badung, Bali, Indonesia. He has been completed the elementary school at SD Negeri No. 12 Denpasar in 1979. The author graduated a junior high school in SMP Negeri 1 Tabanan in 1982 and went on schooling in SMA 1 TP 45 Tabanan in 1985 graduation. SMA graduation was in 1985, the author went on to study of Biology Science Studies, in the Faculty of MIPA at Udayana University, however, in 1986 moved to the Faculty of Agriculture, Department of Agriculture Sciences, Department of Agronomy, University of Udayana and graduated in July 1992. On March 1993, he was accepted as a lecturer of a civil servant at Kopertis Wilayah VIII duties in the University of Tabanan. As a lecturer, the author fostering lectures on Organic Farming, Plant Breeding, Ecology and Experiments Design. Some important positions held by the author at the University of Tabanan, as Vice Dean of the Faculty of Agriculture, Head of Research and Community Service and the Chairman of the Training Center from October 2012 until now, is believed to be the author of the First Vice Rector in University of Tabanan, with the rank of Trustees of the Level I, IVb grade, functional position is Associate Professor.</p> <p>Email: karnata.nengah@gmail.com</p>
	<p>My name is Anak Agung Gede Putra. I used to be called Gung Putra by my family and friends. My parents are Anak Agung Gde Agung Ariawan (late) and Sang Ayu Rai, I was born in Gianyar, Bali on November 7, 1962. I am a male, was the son number two of four brothers. My father was a farmer and former as secretary of the village, while my mother was a grocer in the village. I began my education in 1968, at 6 years old. I started my elementary school in SD No. 1 Manuaba, Gianyar, Bali. There was not a lot of special things that happened during my elementary school. In 1974, I graduated from SD No. 1 Manuaba, Gianyar, Bali and continue to pursue secondary school education. Precisely at SMP Negeri Tegallalang, Gianyar. During the junior high school period at SMP Negeri Tegallalang, I participated in badminton extracurricular activities. I also actively attended additional courses. In term of these are very supportive of my ability during the study in junior high school. Badminton through extracurricular activities, I managed to perform only at school level because at that time the facilities and budgets to support the achievement were very limited. I then graduated at SMP Negeri Tegallalang in 1977 and continue to senior high school in SMA PSKD IV Jakarta. When I was a high school in Jakarta, I lived in with my sister who lives in Jalan Gandaria, South Jakarta. My high school academically was achievement the top rank under 5 in the school. I graduated from high school in 1981, then continued to study in Bali, at the Faculty of Agriculture, University of Mahasaraswati Denpasar. I chose the Faculty of Agriculture attracted in biology sciences and environment especially, fond of plants at making the environment green and cool. In 1986, I graduated from the Faculty of Agriculture. In 1989, I am accepted as a lecturer at Kopertis Wilayah VIII.</p>